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Population Assessment of Lake Clark Sockeye Salmon

Annual Report for Study 00-042

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

EXECUTIVE SUMMARY

Recent declines in the number of sockeye salmon returning to Lake Clark has caused economic hardship in the region and raised resource concerns among local subsistence users and federal managers. This report describes the first year of a two-year study that seeks to identify sockeye salmon spawning areas using radio telemetry, describe genetic variation within and divergence among spawning populations, and train local Native high school student interns to use scientific fisheries techniques. One hundred seventy-five adult sockeye salmon were captured by seine net at the outlet of Lake Clark during July 14 to August 23, 2000, fitted with esophageal radio transmitters, and tracked from boats and airplanes to their spawning grounds. Over 15 previously undocumented spawning aggregations were identified. Fin clips were collected from 1,511 sockeye salmon sampled at 17 different spawning sites. Tissue samples from 957 of these fin clips, representing 10 spawning populations, were genotyped at 11 microsatellite loci and analyzed for genetic variation and population differentiation. All loci were polymorphic, and the number of alleles per population and locus ranged from 2 to 12. There was no evidence of differentiation among sockeye salmon sampled from common populations in different years, so years were pooled within populations for further analysis. All 10 populations assayed were in Hardy-Weinberg proportions indicating random mating within sampled populations. Significant differentiation was found between populations of lower and upper Lake Clark. There was a weak but significant tendency for Kijik River and Lake sockeye salmon to be differentiated from other populations of upper Lake Clark, and a strong tendency for Sucker Bay Lake sockeye salmon to be differentiated from all other populations in Lake Clark. These patterns of divergence do not correspond to major differences in spawning habitat, so Lake Clark may be a promising system to study local adaptation to spawning habitats. This project was developed in consultation with the National Park Service, the Alaska Department of Fish and Game, and various tribal, local, and regional organizations, including Kijik Corporation, Nondalton Tribal Council, Igiugig Village Council, Lake and Peninsula Borough Assembly, and schools within the Native Villages of Newhalen, Iliamna, and Nondalton. Two Native Alaskan high school students were hired as interns to assist with the salmon research program.

Keywords: Sockeye salmon *Oncorhynchus nerka*, spawning areas, population structure, radio telemetry, genetic analysis, microsatellites, subsistence fishery, Lake Clark National Park and Preserve, Kvichak River, Bristol Bay, southwest Alaska.

INTRODUCTION

Recent declines in the number of sockeye salmon returning to Lake Clark has caused economic hardship in the region and raised resource concerns among local subsistence users and federal managers. A lack of information regarding basic sockeye salmon ecology and dynamics exists in this area and a prioritized list of information needs was developed with regional stakeholders. Three priority needs are: to locate all spawning aggregations; develop genetic markers; and train local Native Alaskans in fisheries techniques. Identifying spawning habitat will allow conservation in the face of increasing shoreline development. Genetic "fingerprints" of Lake Clark spawning aggregations will help in differentiating Lake Clark sockeye from sockeye salmon originating from other lake systems (an important tool in allocation issues). Training of local Native Alaskans in scientific fisheries techniques will increase their local economic and educational opportunities, and will empower them to monitor and perpetuate tribal resource interests.

Alaska Natives of the Lake Clark region have relied on annual sockeye salmon returns for their subsistence since prehistoric times (Unrau 1992), and salmon play an integral role in Alaskan Native culture. Residents of Newhalen, Iliamna, Nondalton and Pt. Alsworth annually harvest an estimated 40,042 fish (est. 200,210 lbs) of sockeye salmon for their subsistence needs, although not all users in the area report their harvest (Molly Ahythlook, Alaska Department of Fish and Game, Dillingham, Alaska, personal communication). Salmon are the most important subsistence resource in the region, comprising up to 75% of the total subsistence harvest.

The Bristol Bay commercial salmon fishery is the world's most lucrative commercial salmon fishery, and Lake Clark contributes, on average, about 30% of commercial harvest from the Kvichak River system (Rogers et al. 1997. Recently, sockeye salmon runs to Bristol Bay have dramatically declined to about 2.3% of the previous eight-year average (Rogers et al. 1999). This has greatly impacted both subsistence and commercial fishers in the region, and led the Governor of Alaska to declare the region an economic disaster area in1998 (Anchorage Daily News, Sunday July 12, 1998). Subsistence users in Iliamna, Newhalen, Nondalton, and Pt. Alsworth reported a 1998 subsistence harvest of 31,979 sockeye salmon, which was 8,063 sockeye salmon (40, 315 lbs) less than the 1988-1997 average annual harvest (Molly Ahythlook, Alaska Department of Fish and Game, Dillingham, Alaska, personal communication). Discussions and interviews with local residents confirm that changes have occurred in the distribution and abundance of sockeye salmon within Lake Clark.

Basic information regarding ecology and population dynamics of Lake Clark sockeye salmon is currently lacking. For example, in Lake Clark the location of many spawning aggregations is unknown. Aerial survey data is limited to clear water areas, but about half of the system is quite turbid due to glacial influence. Research in Tustumena Lake on the Kenai Peninsula indicated 30% of sockeye salmon spawned in glacially turbid water along the lakeshore (Burger et al. 1995). Historic data collected for Lake Clark since 1920 (Regnart 1998, Rogers et al. 1999), indicate that large numbers of sockeye salmon entering Lake Clark to spawn annually are not

accounted for in aerial survey counts. If salmon are spawning in glacial areas within Lake Clark, current shoreline and streamside development could inadvertently harm spawning habitats if protective guidelines are not in place. Therefore, documenting the location of all Lake Clark spawning aggregations is important information needed to protect habitat and maintain productive salmon runs. Radio telemetry is an effective method to determine presence or absence of spawning aggregations in glacial habitats of Lake Clark.

Another identified information priority is describing relationships among spawning aggregations within Lake Clark as part of wider efforts to accurately represent Bristol Bay sockeye salmon stock structure. Developing genetic tools to help managers distinguish among sockeye salmon originating from different systems is a critical first step toward addressing future allocation issues. Genetic diversity is also a key issue in managing and conserving fishery resources. The genetic diversity of a population is positively correlated with its degree of population subdivision (Altukhov 1981) and is positively correlated with a species' resilience to disturbance (Giesel 1974). Gene flow among spawning populations of salmon may be limited by differences in run timing (temporal isolation) or geographic distance (spatial isolation) (Ricker 1972, Woody 2000). Temporal or spatial isolation may lead to genetic divergence among populations, which also lends resiliency to a species (Giesel 1974, Stearns 1992).

OBJECTIVES

1) Determine spawning habitats through radio telemetry
2) Determine the genetic "fingerprint" of Lake Clark sockeye salmon.
3) Identify and train a local Native intern(s) in application of scientific fisheries techniques and encourage and assist that person in attaining higher educational goals.

METHODS

Radio Tagging and Tracking

Sockeye salmon were captured by seine net at the outlet of Lake Clark just upstream from its confluence with Six-Mile Lake. The seine net was about 60 m long, the first 30 m about 2.5 m deep, and the last 30 m about 3.5 m deep. Mesh size was about 10 cm. Fishing efforts began on July 6 when the first net was set and ended on August 23, 2000 when the last radio tag was deployed. The number of sockeye salmon fitted with radio tags each week was weighted by in-season Newhalen River escapement estimates from the University of Washington counting tower. A random number generator was used to determine two daily fishing times, one between the hours of 0600 hours and 1200 hours (morning) and the other between 1200 hours and 1800 hours (afternoon). Fishing effort was equally divided each day between the morning and afternoon hours and was distributed randomly throughout these two time periods. Each fishing session started when the net was set and ended when either three sockeye salmon were caught and tagged or two hours had passed without catching any sockeye salmon. No more than six sockeye salmon, three in the morning and three in the evening, were tagged daily. Both the east and west shores were fished. Most sockeye salmon were captured on the east shore since there appeared to be a higher density and more predictable migration of sockeye salmon on the east shore. It was also easier to fish on the east shore due to the presence of a large eddy where sockeye salmon tended to congregate. Daily catch-per-unit-effort was calculated at the total number of sockeye salmon captured per minute of fishing per day.

Tagging procedures followed those of Burger et al. (1995). Sockeye salmon were anesthetized in a natural clove oil (50 mg/l) and lake water solution (Woody and Nelson 2000) for two to three minutes before being placed in a cradle. With their ventral side facing up and their lower jaw raised, a glycerin coated radio transmitter was introduced into the anterior portion of their stomach with a Plexiglas tube designed by Monan et al. (1975). The transmitter antenna was allowed to protrude from the mouth of the sockeye salmon. Mid-eye to hypural plate, fork length, a scale sample, and sex was recorded. Tagged sockeye salmon were allowed to recover in a live box containing aerated lake water and released at the point of capture.

The specific radio transmitter selected for the study is a series transmitter (model MCFT-3B) manufactured by Lotek Engineering Inc., Newmarket, Ontario. The digitally encoded transmitter provided a distinct code to each tag. This allowed more than one tag to be placed on a frequency, thereby reducing total scan time during tracking. We purchased 175 transmitters that were used on and 20 distinct frequencies, with 8 or 9 transmitters digitally encoded per frequency. No more than five sockeye salmon were tagged each day, and each fish tagged during the same day was assigned a different frequency. The burst rate (interval of time at which each tag emitted a pulse) was set to 2 seconds, and the scan rate of the receiver was programmed to 2.3 seconds. This allowed two people in an aircraft to scan all twenty frequencies in 23 seconds, which, at an average flight speed of 80 mph, was the time it took to cover 1 kilometer.

The MCFT-3B tag used was 14.5 mm long and 43 mm in diameter. It weighed 10.5 grams in air, 4.1 grams in water, and had an expected operational life (at a preprogrammed burst rate of 2.5 seconds) of 142 days. Using a tag of this size allowed us to tag sockeye salmon at least as small as 420 mm with little probability of regurgitation, stomach rupture, or other problems due to tag size (Burger et al.1995). Lake Clark sockeye salmon captured in the subsistence fishery ranged in length from 450 to 650 cm when sampled by the Fisheries Research Institute in 1967 (Mathisen and Poe 1969), although was likely that smaller individuals would be encountered. The tag was programmed to transmit 24 hrs/d, which allowed us to record movements at two remote automated stations at the Kijik and Tlikakila rivers. Tag life exceeded estimated peak-spawning times of all previously identified Lake Clark spawning populations (Demory et al. 1964; Regnart 1998). The transmitters were programmed to VHF (very high frequency) in the range of 150-160 MHz. Although propagation losses in water (the amount of radio energy lost as a result of traveling through water) are higher with increasing frequency, the losses are not significant when other variables are considered. For example, at 50 MHz an efficient receiving antenna would need to be much longer than is physically manageable and would result in decreased overall system performance. Other factors, such as the transmitter radiated power (the radiating efficiency of the tag antenna) and the receiver sensitivity, benefit from the use of a higher frequency. As a general rule, noise diminishes with increasing frequency, which results in a greater capability of decoding the transmitter's signal (Sisak and Lotimer 1997). Lotek high frequency tags can be detected up to 10 m below the water surface from 2 km. Prior to tracking migrating sockeye salmon, the distance and depth of detection by boat and aircraft was determined.

A study of retention of radio tags by adult sockeye salmon was done by the authors in 1999 and replicated in 2000. Tagged and untagged sockeye salmon were held for 15 days in 1999 and 35 days in 2000. Radio tags were retained by adult sockeye salmon of a wide range of body sizes, and tagging did not increase mortality among adult sockeye salmon.

Sockeye salmon were followed immediately after release (boat tracking) to determine migration patterns from the outlet, through the lake, and to spawning grounds. Migration route tracking occurred at three points in the run: early, peak and late (based on Newhalen tower estimates by University of Washington investigators). Boat tracking was done by two observers, each with a radio receiver, and conducted over a period of five days. Aerial tracking occurred once weekly. A similar sampling regime was previously found to be sufficient to locate a similar number of radio tags in a system of comparable size (Tustumena Lake, Burger et al. 1995).

Encoding up to10 transmitters per frequency on 20 frequencies would allow up to 200 tags to be tracked at once using two receivers. Two people (in addition to the pilot) were used to complete each aerial survey. Radio tags were deployed throughout the entire run and, once a tagged sockeye salmon was located in a likely spawning location over a two-week period, the tag was removed from the scanning frequency. The receiver/data logger used was the model SRX_400 W30, manufactured by LOTEK Engineering, Inc. and engineered for use with digitally encoded transmitters. Two H-antennas were used for foot, boat and aerial tracking. It was expected that tracking by boat would be sufficient in the first month as sockeye salmon migrated through the

lake and milled at the mouth of spawning tributaries. Aerial surveys were conducted over the whole system once sockeye salmon began to enter inlet tributaries. Surveys were flown once per week during late July through early September and again in mid-October. It was estimated an aerial survey of the Lake Clark watershed would take over 8 hours, requiring an estimated total of 120 hours of flight time.

Tracking data were integrated into an ARCVIEW database for Lake Clark to create maps of salmon movements and final spawning destinations.

Genetic Sampling

Six of eight spawning populations previously sampled by the authors in 1999 were also sampled in 2000, including lower Tlikakila River, Little Lake Clark, Kijik Lake South Beach, Little Kijik River, Chulitna Bay, and Chulitna Lodge beaches. Tuk'eleh stream was not sampled in 2000 as low water levels blocked fish passage. Upper Tlikakila River was also not sampled in 2000 as early freezing and snowfall made it inaccessible to aircraft. An additional 11 spawning sites were surveyed for the first time in 2000: Tazimina River Sucker Bay Lake outlet, Jack Ross Bay, Chi Point, Kijik terminus beaches, Tommy Creek beach, Middle Ridge beach, Currant Creek terminus beach, Hatchet Point beach, and Portage Creek terminus beaches. Sampling consisted of collecting fin clips and measuring hypural lengths of both male and female sockeye salmon. Attempts were made to sample 100 sockeye salmon (50 males and 50 females) from each major spawning population.

In addition to fin clips, otoliths were collected from each spawning population surveyed. Otoliths were typically collected from spawned out sockeye salmon to avoid killing individuals that had not yet spawned. The number of otoliths collected from each population varied greatly, largely depending on timing of the surveys in relation to spawning. In two surveys, additional otoliths were collected from spawning males captured in the subsistence fishery. Otoliths will be used to determine ages.

Genetic Analysis

All fin tissue samples were catalogued and archived. Samples are being analyzed as part of a collaborative research effort with the Alaska Department of Fish and Game to "fingerprint" Bristol Bay sockeye salmon populations. Preliminary work toward constructing a series of multiplexes to genotype tissues on the Li-Cor was conducted. DNA from the first 25 males and females from each population sampled was extracted. A total of six loci were confirmed to work in Lake Clark sockeye salmon and their PCR profiles and concentrations optimized. Loci were

organized into two working multiplexes of three. All six of these loci are also being used by Alaska Department of Fish and Game.

Allele frequencies at each locus were determined and compared to assess levels of differentiation among and heterozygosities within spawning populations. An approximation of Fisher's exact test to determine differences in allele frequencies and Chi-square tests for conformity to Hardy-Weinberg equilibrium was calculated in GENEPOP (Raymond and Rousset 1997). Hierarchical F-statistics to test for genetic differentiation among populations were computed by FSTAT (Goudet 1995) according to Weir and Cockerham (1984). Genetic distances between populations were calculated according to Cavalli-Sforza and Edwards (1967) and Nei in PHYLIP (Felsenstein 1993). Samples were stratified by run time, spawn time, spawning location, and geographic distance. Total genetic variation detected will be partitioned among these levels of population structure using AMOVA in Arlequin.

Consultations and Capacity Development

An important aspect of this project was to recruit one or two student interns, identified by tribal councils and their own interest, to learn more about fisheries biology and management by assisting (as a paid intern) with all different aspects of this project. It was the intent of these efforts to pique the interest and desire for further education (Bachelors level) in fisheries science for young Native Alaskans and to promote partnerships among agencies and Native villages. The Tribal Councils also desired to increase job and educational possibilities for local youth, and to retain these youth to assist with input to and management of local fisheries subsistence resources.

RESULTS AND DISCUSSION

Radio Tagging and Tracking

During Just 14 to August 23, 2000, a total of 343 sockeye salmon were sampled from seine catches, and 175 of these were fitted with esophageal radio tags. Over 15 previously undocumented spawning aggregations were verified through this tracking program (Figure 1).

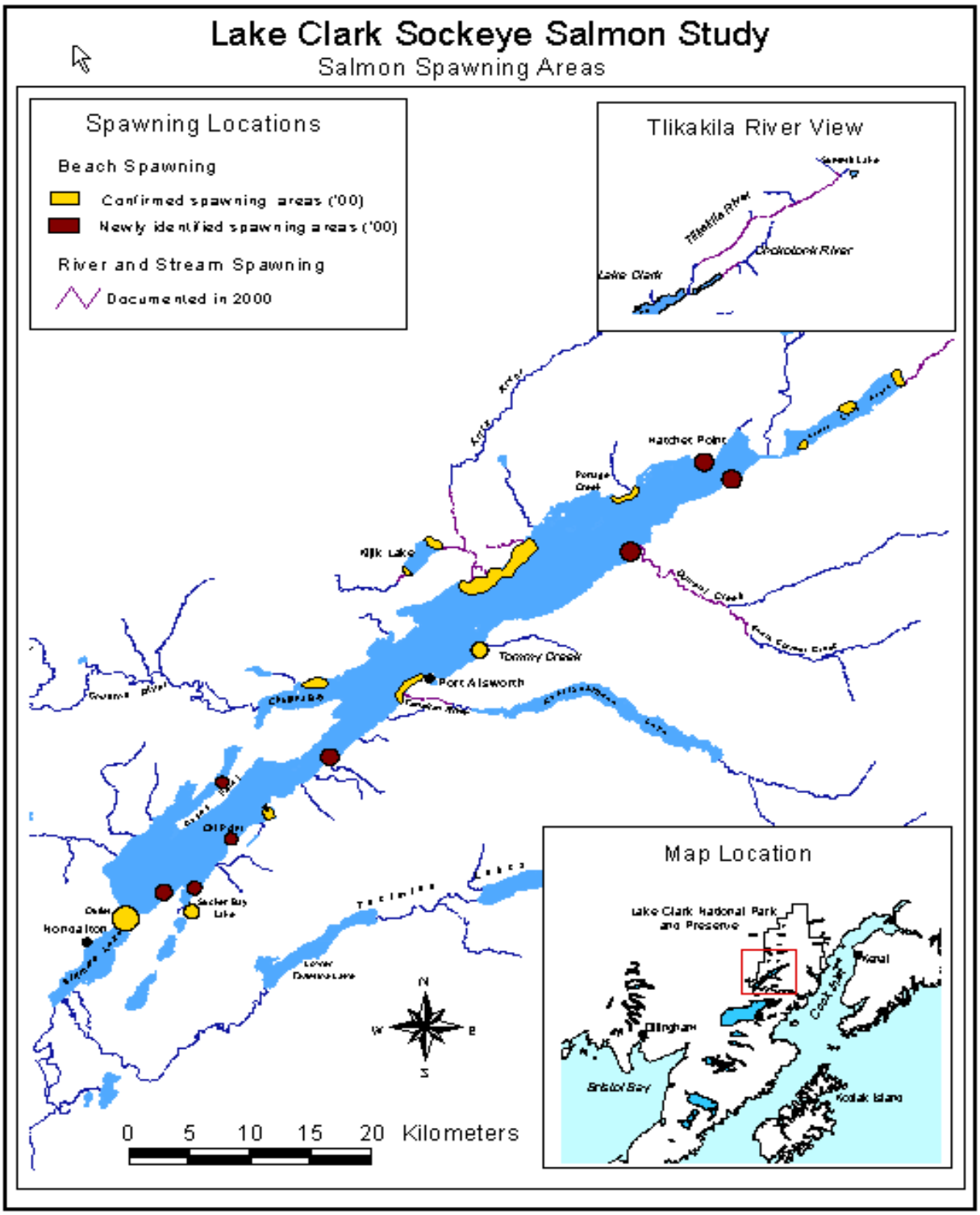
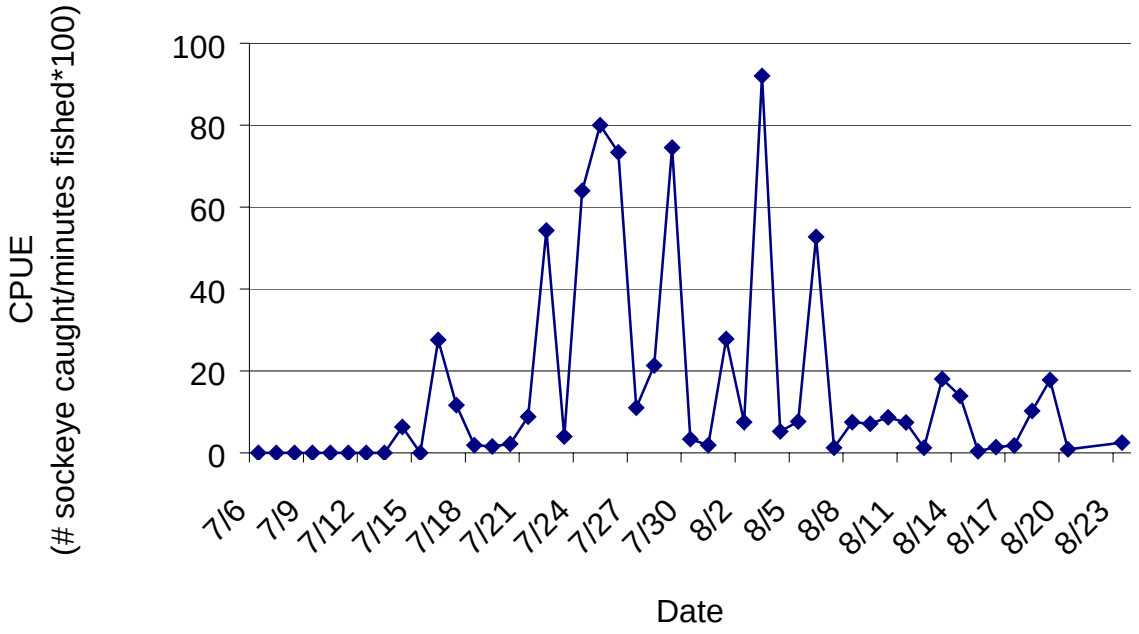


Figure 1. Sockeye salmon spawning aggregations in Lake Clark as determined through radio telemetry and ground verification, 2000.

Assuming that catch-per-unit-effort was proportional to abundance, most sockeye salmon



migrated past the outlet between July 22 and August 6, 2000 (Figure 2).

Figure 2. Catch-per-unit-effort for sockeye salmon tagged with radio transmitters at the outlet of Lake Clark, 2000.

Genetic Sampling

Fin clips were collected from a total of 1,511 sockeye salmon sampled at 17 different spawning sites (Table 1, Figure 3). Although it was not possible to collect 100 fin clips from every spawning population sampled, minimum sample sizes of 30 fin clips from each sex were obtained from all populations. A total of 1,037 otoliths were also collected.

Table 1. Number of fin clips and otoliths collected from sockeye salmon sampled from spawning areas in Lake Clark, 2000.

			Samples Collected					
			Fin Clips			Otoliths		
Spawning Area		Survey Dates (2000)	M	F	Total	M	F	Total
Tazimina	TAZ	8/18-19	44	24	68	18	35	53
Sucker Bay Lake	SBL	8/21, 9/13	50	50	100	37	33	70
Outlet	OUT	9/16, 9/26-27	42	45	87	10	38	48
Little Kijik River	LKR	9/13, 9/20-21	50	50	100	51	62	113
Jack Ross Bay	JRB	9/19	45	43	88	40	40	80
Kijik Lake South Beach	KLSB	9/21-22	50	50	100	62	80	142
Chi Point	CHI	9/24	50	50	100	16	16	32
Chulitna Lodge	CLDG	9/25	50	50	100	30	33	63
Kijik Mouth Beach	KMB	9/30	50	50	100	41	25	66
Chulitna Bay	CBY	10/1	50	50	100	30	30	60
Little Lake Clark	LLC	10/6-9	38	42	80	13	23	36
Tommy Creek Beach	TCB	10/7	50	50	100	16	38	54
Lower Tlikakila	LTLK	10/11-12	50	50	100	30	30	60
Middle Ridge Beach	MRB	10/19	9	26	35	8	19	27
Currant Outlet Beach	COB	10/23, 10/27-8	7	83	90	5	44	49
Hatchet Point Beach	HPB	10/17-18, 10/27-28	24	57	81	6	23	29
Portage Creek Beach	PCB	10/12, 10/17-18	32	50	82	14	41	55
Totals			691	820	1511	427	610	1037

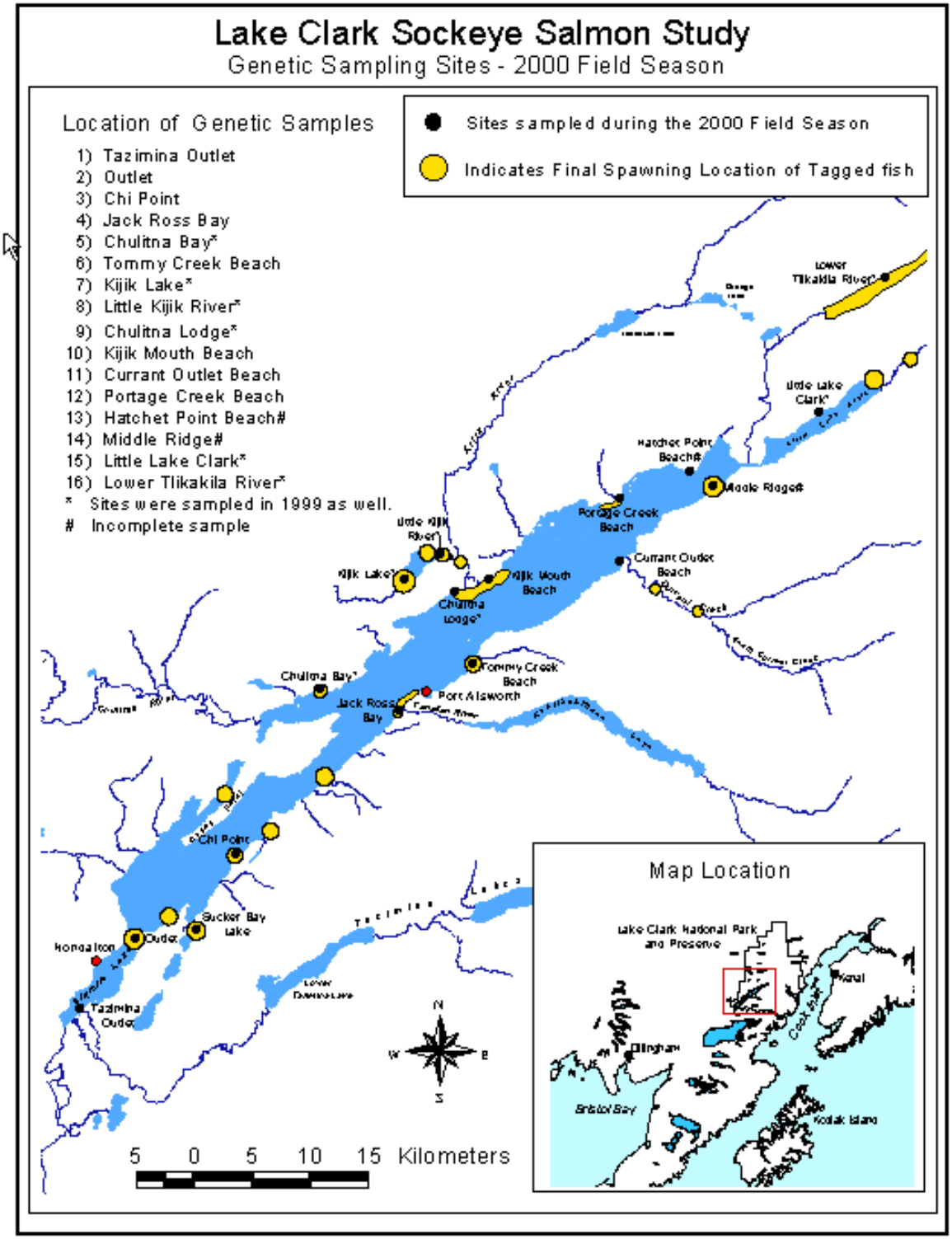


Figure 3. Genetic sampling site locations for Lake Clark sockeye salmon, 2000.

Genetic Analysis

Tissue samples collected from 957 spawning sockeye salmon from 10 spawning populations were genotyped at 11 microsatellite loci and analyzed for genetic variation and population differentiation. The number of sockeye salmon samples analyzed per population ranged from 47 to 207.

All loci were polymorphic with Oki1-1, Oki1-2, Omy325, µSat60, Oneµ21, Ots3, Oneµ18, Oneµ13, One105, Ots107 and Omy77 having 4, 6, 15, 8, 15, 10, 9, 10, 9, 6, 7, and 9 alleles, respectively. The number of alleles per population and locus ranged from 2 (Oki1-1) to 12 (Omy325). There was no evidence of differentiation among sockeye salmon sampled from common populations in different years, so years were pooled within populations for further analysis.

All 10 populations assayed were in Hardy-Weinberg proportions indicating random mating within sampled populations. Panmixia within populations was also suggested by F_{IS} values that approximated zero for all populations. Mean expected heterozygosity among populations ranged from 0.45 to 0.52, and mean number of alleles per population and locus ranged from 4.2 to 5.9. This indicates that genetic variation is similar among populations. This level of genetic variation among Lake Clark sockeye salmon is moderate and similar to that found in other populations of Alaskan sockeye salmon.

There is significant differentiation among spawning populations of Lake Clark sockeye salmon. Allele frequencies differed significantly for at least one locus in 36 of 45 pairwise comparisons between populations. The F_{ST}, a measure of the total genetic variation due to divergence between populations, was significantly greater than zero in 33 of 45 pairwise comparisons. Both analyses suggest the same pattern of differentiation: 1) divergence between populations of lower (Sucker Bay Lake, Lake Clark Outlet, Tazimina River) and upper Lake Clark (all other populations assayed); 2) a weak but significant tendency for Kijik sockeye salmon (Little Kijik River, Kijik Lake South Beach) to be differentiated from other populations of upper Lake Clark; and 3) a strong tendency for Sucker Bay Lake sockeye salmon to be differentiated from all other populations in Lake Clark. These patterns of divergence do not correspond to major differences in spawning habitat (for example, beach versus tributary or glacial versus clear). This makes Lake Clark a promising system for studies of local adaptation to spawning habitats. While the pattern of genetic divergence described to date can be visually represented (Figures 4 and 5), caution is required in their interpretation since outgroups (Iliamna, Tustumena) have not yet been included in this analysis.

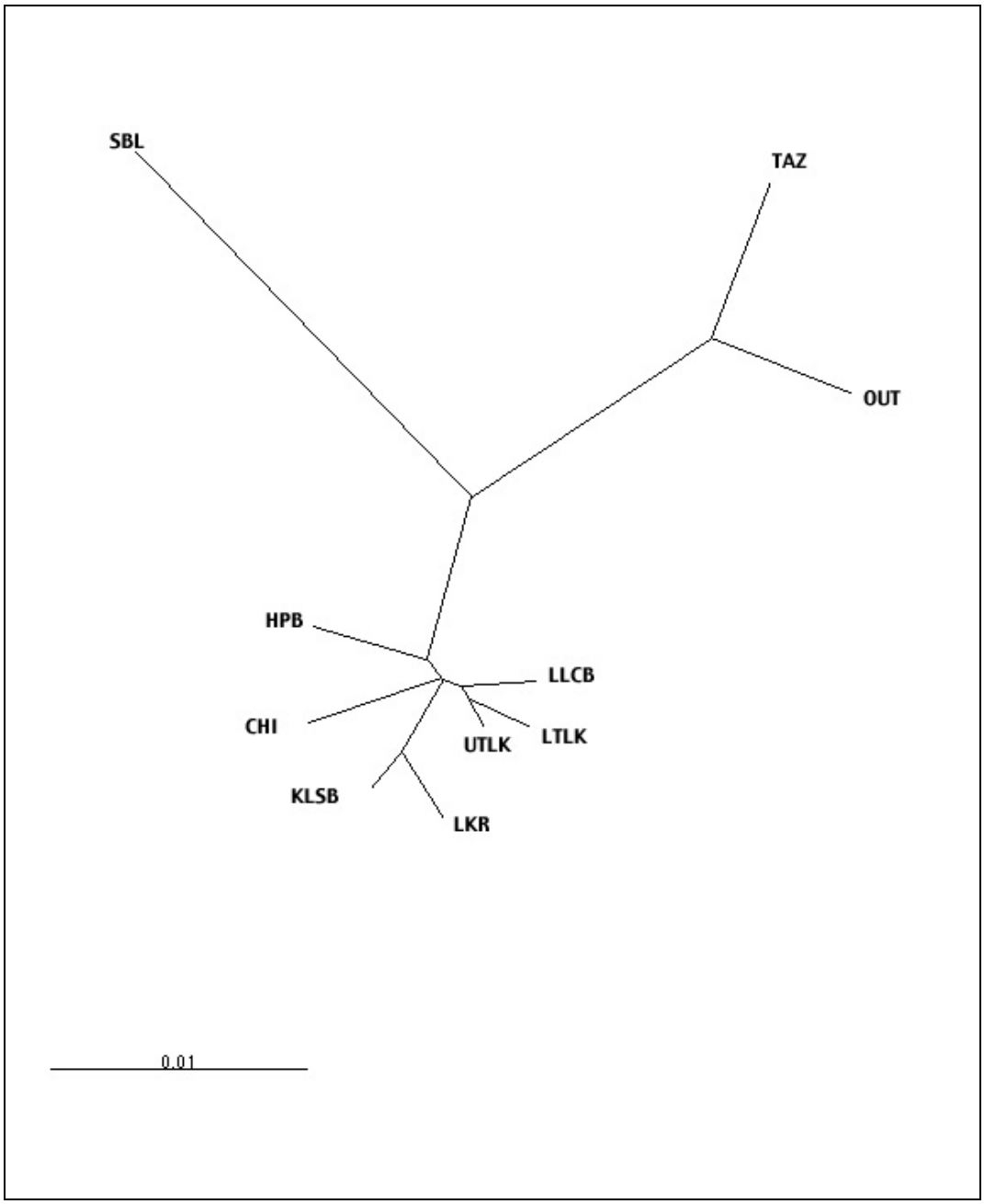


Figure 4. Neighbor joining tree for Lake Clark sockeye salmon based on Cavalli-Sforza and Edwards genetic distance. Abbreviations used for Sucker Bay Lake (SBL), Tazimina River (TAZ)), Lake Clark Outlet (OUT), HPB, CHI Kijik Lake South Beach (KLSB), Little Kijik River (LKR), Upper Tlikakila River (UTLK), Lower Tlikakila River (LTLK), and Little Lake Clark Beach (LLCB).

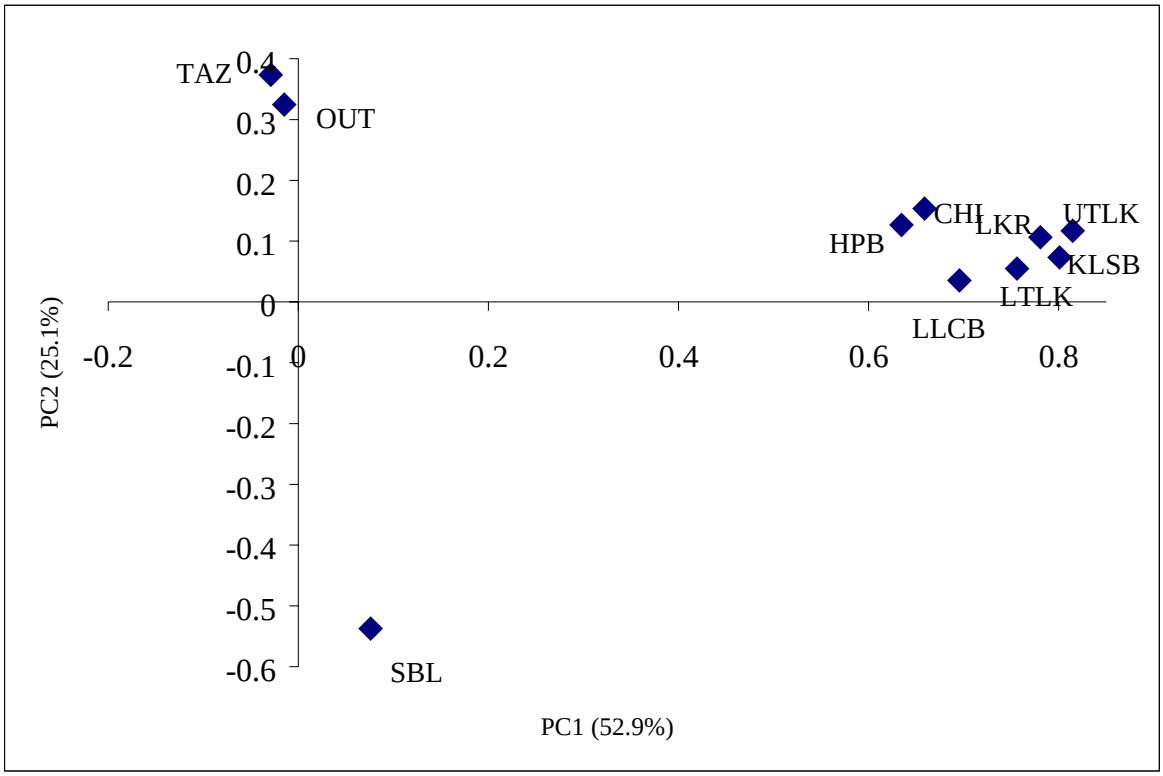


Figure 5. Principal Component Analysis scatter plot of Lake Clark sockeye salmon population scores on principal components 1 and 2. Amount of total variation explained by each component in parentheses. Abbreviations used for Sucker Bay Lake (SBL), Tazimina River (TAZ)), Lake Clark Outlet (OUT), HPB, CHI Kijik Lake South Beach (KLSB), Little Kijik River (LKR), Upper Tlikakila River (UTLK), Lower Tlikaklia River (LTLK), and Little Lake Clark Beach (LLCB).

Consultations and Capacity Development

This project was developed in consultation with the National Park Service, the Alaska Department of Fish and Game, and various tribal, local, and regional organizations, including local schools. Meetings were held with Kijik Corporation, Nondalton Tribal Council, Igiugig Village Council, Lake and Peninsula Borough Assembly, and schools within the Native Villages of Newhalen, Iliamna, and Nondalton. The purpose of meetings with these organizations was to discuss issues relative to Lake Clark sockeye salmon studies, gain local support and approval for a study, and to recruit student interns as study assistants. Two Native Alaskan high school students, Kristy Balluta and Janell Kukaruk, were hired as interns to assist with the salmon research program (Figure 6). The girls, honor students from Nondalton, helped capture, measure, sample, tag, and track sockeye salmon as part of the research program. Both young

women have expressed an interest in continuing their working with the program in the future. Meetings with agencies and organizations continued to be held once the study was begun to update them on its progress and findings.

Figure 6. Kristy Balluta and Janell Kukaruk, student interns from Nondalton, place a newly tagged sockeye salmon into a recovery pen.

RECOMMENDATIONS

Radio Tagging and Tracking

1. Repeat radio tagging and tracking in 2001 to determine whether all spawning populations have been identified, including spawning locations and times.
2. Examine data to determine whether sockeye salmon having spawning coloration at time of tagging had a higher probability of spawning at the outlet of Lake Clark. This would help ensure that outlet spawners are not over represented in the tagging sample.
3. Examine data to determine whether final spawning destination is independent of tagging location. This would help determining whether it is necessary to tag equal numbers of sockeye salmon on the east and west shores of the narrows in 2001.
4. Continue efforts to find a better fishing method or location on the west shore of the outlet narrows.
5. Examine age and genetic composition of the run through time based on results of tagging data

Genetic Sampling and Analysis

1. In 2001, collect fin clips from previously sampled spawning populations if they have been sampled only one other year.
2. In 2001, collect fin clips from any newly identified spawning populations.
3. Continue extracting DNA from all fin clips collected.
4. Continue loci selection, multiplex construction, and genotyping.

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We thank the communities of Nondalton and Port Alsworth for their interest and support of this project. In particular, Andrew Balluta helped us with the capture of sockeye salmon and provided excellent information on spawning areas in Lake Clark. Doug Palmer, Randy Brown, Beth Kitto-Spangler, and Rob Spangler provided helpful guidance with the telemetry equipment. Pat Poe provided encyclopedic knowledge of Lake Clark sockeye salmon and information regarding historic aerial surveys. Volunteers and seasonal technicians provided support in all aspects of the study. Many thanks are due Ghazal Ataian for collecting genotypes and to all who assisted in fieldwork. The U.S. Fish and Wildlife Service, Office of Subsistence Management, provided funding support for this project through the Fisheries Resource Monitoring Program,

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